REMARKS

Claims 1-28, 51, 56-64, and 76-78 are pending, of which Claims 1, 56 and 76 are independent.

Applicants note with appreciation that Claim 19 was found allowable if rewritten in independent form. Claims 1-3, 5-11, 13-18, 22-27, 51, 56-64 and 76-78 were rejected under 35 U.S.C. 102(b) as anticipated by U.S. Patent No. 5,775,109 by Eacobacci Jr. et al. ("Eacobacci"). Claims 4, 20 and 28 were rejected under 35 U.S.C. 103(a) based on Eacobacci in view of U.S. Patent No. 5,551,248 to Derosier ("Derosier"). Claims 12 and 21 were rejected under 35 U.S.C. 103(a) as obvious in view of Eacobacci.

The Applicants appreciated the opportunity to speak with the Examiner on this case. In view of the Examiner's comments, Applicants have made an effort to clarify the claimed subject matter to put this case in condition for allowance. Independent claim 1 has been amended to clarify that a controller performs the various measures, including the determination of refrigerant demand. Independent claims 56 and 76 already recite the limitation of a controller. Independent claims 1, 56 and 76 have also been appropriately amended to clarify that the demands or requirements of refrigerant at a refrigerator may be based on the refrigerant's operation, and that the allocation of refrigerant reflects that an allocation of refrigerant is based on the operation of a particular refrigerator with respect to the other refrigerators.

Briefly, the present invention teaches a method and system for managing a supply of refrigerant among a group of refrigerators by determining the operational demand of each of the refrigerators in the group based on the "particular operation that the cryogenic refrigerator is performing," and allocating accordingly. Specification, Page 4, lines 3-9.

One embodiment of the present invention, as set forth in independent Claim 1, as amended, reads:

> 1. A method for controlling distribution of refrigerant among a plurality of refrigerators comprising:
>
> at a controller, determining an available quantity of the refrigerant;
>
> at a controller, determining a demand of the refrigerant by each of the plurality of refrigerators, the demand depending on the operation of each refrigerator;

at a controller, aggregating the refrigerant demand of the refrigerators;

at a controller, determining, for each of the refrigerators, an allocation of the refrigerant based on the availability of the refrigerant, the aggregated refrigerant demand and the individual refrigerant demands of the refrigerators with respect to the other refrigerators, the allocation computed as a portion of the determined available quantity;

distributing the refrigerant to the refrigerators based on the determined allocation; and

redistributing the refrigerant over time by redetermining the allocation of the refrigerant.

I. The Rejections Under 35 U.S.C. 102(b)

Claims 1-3, 5-11, 13-18, 22-27, 51, 56-64 and 76-78 were rejected under 35 U.S.C. 102(b) as anticipated by Eacobacci. In citing Eacobacci, however, the Examiner has apparently confused the prior art problem identified by Eacobacci, with the solution presented by Eacobacci. Applicants respectfully submit that the solution provided by the present invention is neither anticipated nor suggested by either the prior art problem identified by Eacobacci or the solution presented by Eacobacci.

A. The Problem Identified by Eacobacci and the Present Invention

The Examiner has cited a passage from Eacobacci that discusses through a numerical analysis, a prior art system that demonstrates problems addressed by Eacobacci. Col. 5, line 28 – Col. 6, line 18. In the example in the cited passage, a common helium supply manifold can supply three refrigerators with 51 standard cubic feet per minute (scfm) of compressed helium gas. The first two refrigerators are already in a cold state, and require only 17 scfm of helium to achieve their rated performance. Col. 5, lines 34-35. However, in the absence of any constraint, these two refrigerators are capable of drawing 25 scfm of helium from the manifold. Col. 5, lines 35-39. A warm refrigerator that seeks to cool down may only be capable of drawing 5 scfm of helium.

In the prior art system of the cited passage, where the refrigerators "contest for a now-scarce supply of compressed gas," the compressor supplies an amount of helium refrigerant based on a "refrigerator's maximum consumption (at the given temperature) multiplied by the ratio of the available supply over the present aggregate maximum consumption of all

refrigerators." Eacobacci, Col. 5, lines 17-22 (emphasis added). It should be noted that no computation is performed; the respective refrigerators naturally draw the indicated amount of helium. Thus, the two cold refrigerators draw 23.2 scfm of helium (more than needed to achieve their rated performance); and the warm refrigerator that is trying to cooldown receives only 4.6 scfm (less than its maximum draw), which slows its cooldown process. Col. 6, lines 3-18. With respect to the system described in the cited passage, no comparison, computation, or ***determination*** is performed based on the operation of a particular refrigerator with respect to the other refrigerators. The refrigerators naturally draw the helium based on their capable consumption.

As discussed in Eacobacci, this prior art system results in warmer refrigerators obtaining less than optimal amounts of refrigerant flow, thus preventing an optimal cooldown rate of those warmer refrigerators. Eacobacci, Col. 6, lines 3-19. This is a problem also mentioned by the present application. Page 2, lines 5-29. In referencing Eacobacci, the Specification of the present invention continues:

> Frequently, however, a common helium supply manifold supplying a plurality of cryopumps is capable of supplying more helium than required by all of the cryopumps. Excess helium which is not identified is often unutilized, which can increase the time required for cooldown and which can cause a cryogenic refrigerator to become colder than needed, wasting power and other resources required to maintain the helium refrigerant supply.

Specification, Page 2, lines 24-29.

Thus, both Eacobacci and the present invention identify a problem with prior art helium supply systems: lack of supply management may result in wasted resources and inefficient use of refrigerant supply.

B. <u>Eacobacci</u>

Eacobacci provides one solution to the above-identified problem. Eacobacci controls each refrigerator by monitoring the refrigerator temperatures. Each refrigerator so controlled <u>is controlled based on the temperature in relation to a setpoint</u>. There is no aggregation of demand and no allocation is determined. Accordingly, the Eacobacci system may determine that each refrigerator is in need of helium, and therefore allow each refrigerator to attempt to draw a quantity of helium which, in aggregate for all refrigerators so controlled, exceeds the total helium

available. Similarly, the Eacobacci system may determine that each refrigerator is satisfied with respect to the temperature setpoint, and permit helium to be unutilized.

C. The Present Invention

The present invention provides an alternative to Eacobacci. Like Eacobacci, the present invention overcomes the limitations identified in the prior art system discussed above. The present invention measures the demand of individual refrigerators depending on that refrigerator's particular operation. While the prior art system based its allocation on a given refrigerator's maximum draw without determining the actual refrigerant demand, the present invention ***determines*** the operational ***demand*** of a given refrigerator and prorates any allocations based on the refrigerant demand. The method of Independent Claim 1 involves "determining a demand of the refrigerant by ***each*** of the plurality of refrigerators." That demand is aggregated, and an allocation is determined based on three factors: (1) the availability of refrigerants; (2) aggregated refrigerant demand; and (3) the individual demands of the refrigerators. Thus, the individual demands of the individual refrigerators is determined for the purpose of determining of the proper allocation. Support for these amendments can be found in the Specification at Page 4, lines 6-9; Page 6, lines 26-28; and throughout the application. As discussed in the application, in one embodiment of the present invention, an individual refrigerator's demand may be computed by any combination of the following parameters: a minimum helium quantity, a current computed helium consumption rate, an operating mode, and a helium consumption status indicative of helium starvation. In other words, the present invention relates to controlling the supply system by determining the refrigerator needs and allocating the appropriate amount of refrigerant based on that need.

Neither the prior art example, nor Eacobacci teaches the claimed invention of "***determining a demand of the refrigerant be each of the plurality of refrigerators,***" "***aggregating the refrigerant demand,***" and using those calculations in "***determining, for each of the refrigerators, an allocation of the refrigerant based on . . . the aggregated refrigerant demand and the individual demands of the refrigerators***" of representative Claim 1. Applicants respectfully submit that independent Claims 1, 56, and 76 are not anticipated by Eacobacci, and thus are in condition for allowance. Furthermore, Claims 2, 3, 5-11, 13-18, 22-27, 51, 57-64, 77 and 78 are dependent on allowable claims, and therefore are also in condition for allowance.

II. The Rejections Under 35 U.S.C. 103(a)

A. Claims 4, 20 and 28

Claims 4, 20 and 28 were rejected under 35 U.S.C. 103(a) based on Eacobacci in view of Derosier. As discussed above, the prior art example discussed in Col. 5-6 of Eacobacci does not disclose the control of consumption by a refrigerator, and thus it would not be obvious to combine any "slave controller" claimed in Claims 4 and 28, or "incrementally increasing control parameters" claimed in Claim 20; nor would there be any motivation to make that combination given the prior art example. The invention of Eacobacci measures "the temperature of each of the refrigerators and determin[es] whether any of the refrigerators have a temperature below a triggering limit." Col. 4, lines 52-55. Thus, it would not be obvious to combine "slave controller" or "incrementally increasing control parameters;" nor would there be any motivation to make that combination given the Eacobacci disclosure.

Applicants respectfully submit that Claims 4, 20 and 28 are not obvious based on Eacobacci in light of Derosier, and thus are in condition for allowance. In any event, because Claims 4, 20 and 28 are dependent on allowable independent claims, they too are allowable.

B. Claims 12 and 21

Claims 12 and 21 were rejected under 35 U.S.C. 103(a) as obvious in view of Eacobacci. The Examiner has indicated that the dependent claims involving the use of differential pressure as an operating parameter in the control of refrigerant distribution is "partly revealed in the prior art." Yet, the Examiner has failed to cite any prior art references discussing the use of differential pressure as an operating parameter. The cited reference Eacobacci does not discuss the use of differential pressure as an operating parameter, and, in fact, makes no mention of differential pressure at all.

With regards to the Examiner's contention that the Specification does not indicate any criticality with respect to differential pressure, Applicants note that Pages 24-28 discuss particular embodiments of the present invention, wherein differential pressure serves as an operating parameter for the purpose of preventing the sharp degradation of refrigeration capacity. On page 24, lines 25-30 of the Specification, Applicants specifically state:

> In extreme situations, if many cryopumps are consuming helium at a high rate, the pressure differential can drop below a critical

threshold whereby the refrigeration capacity begins to degrade sharply. It is one object of the present system to prevent the pressure differential from falling to the critical threshold.

Applicants respectfully submit that Claims 12 and 21 are not obvious in view of Eacobacci, and thus are in condition for allowance. In any event, because Claims 4, 20 and 28 are dependent on allowable independent claims, Claims 4, 20 and 28 are allowable through dependency.

CONCLUSION

In view of the above remarks, it is believed that all claims are in condition for allowance, and it is respectfully requested that the application be passed to issue. If the Examiner feels that a telephone conference would expedite prosecution of this case, the Examiner is invited to call the undersigned.

Respectfully submitted,

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Dated: 4/12/05